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Concrete Target Response Experiments using Time-Resolved Diagnostics

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Abstract

The design of advanced penetrating weapons for successfully attacking fixed hard targets requires a thorough understanding of the interaction of concrete and rock with high-velocity penetrators. Time-resolved data on the penetrator trajectory and on the pressure field generated by the penetrator within the target are particularly useful for validating the material models contained in the continuum mechanics simulation codes that are used in design and analysis.

The third and fourth experiments in a series devoted to the development and adaptation of measurement techniques for determining the response of concrete and rock targets to penetration were carried out. The techniques used in these experiments included fiber optic arrays and Fabry-Perot velocimetry. Results of the previous two experiments were reported at the 46th Annual Bomb and Warhead Technical Symposium.

In Experiment 3, a 146-mm TOW-2a shaped charge was fired into a 600-mm-diameter concrete cylinder. Crossed fiber optic arrays were used to localize the jet, and five Fabry-Perot probes were placed in a pattern spiraling outward from the centerline to record the radial distribution of the concrete particle velocities.

Experiment 4 used a triangular array of three 66-mm Viper shaped charges fired into a 1.5-m-diameter concrete tub for the purpose of rubblizing a path for an eventual follow-through scaled munition. A crossed fiber optic array was placed 200 mm behind the front face to record the locations and arrival times of the jets.

The CALE hydrodynamic simulation code was used to model various aspects of these penetration experiments, using a generic concrete model. In Experiment 3, the radial dependence of onset, duration, and maxima of the particle velocity records were found to agree in general with the results of a CALE calculation. In Experiment 4, planar calculations with CALE revealed the potential for development of a crack pattern that could account for the extended Y shape seen in the multiple-jet entrance crater.

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